



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: CABIN PRESSURIZATION SYSTEMS
IN SMALL AIRPLANES

Date: 12/30/86
Initiated by: ACE-100

AC No: 23.841-1
Change:

1. PURPOSE. This advisory circular (AC) provides an acceptable means, but not the only means, of showing compliance with the requirements of §§ 23.841(b)(3) and 23.841(b)(6) of the Federal Aviation Regulations (FAR) pertaining to pressurized cabins in small airplanes. This material is neither mandatory nor regulatory in nature and does not constitute a regulation.

2. RELATED FAR SECTIONS. These acceptable means of compliance refer to certain provisions of Part 23 of the FAR and the corresponding provisions of Part 3 of the Civil Air Regulations (CAR) in the case of airplanes for which those regulations are applicable. Listed below are the applicable and the related FAR sections with the corresponding CAR sections shown in parenthesis:

- a. § 23.365 (3.197)
- b. § 23.775(c) (3.383)
- c. § 23.841 (3.395)
- d. § 23.843 (3.396)

3. BACKGROUND. For pressurized cabins in small airplanes, questions have been raised for showing an acceptable means of compliance pertaining to the following requirements in §§ 23.841(b)(3) and 23.841(b)(6):

- a. Provision of a means by which the pressure differential can be rapidly equalized; and
- b. provision of a warning indication at the pilot station to indicate when a cabin pressure altitude of 10,000 feet is exceeded.

4. DISCUSSION OF REQUIREMENTS. In discussing these requirements, a brief history on the development of the applicable airworthiness regulations is first presented. The purpose of the airworthiness requirements for small airplanes is then explained.

- a. Rapidly Equalizing the Pressure.

(1) History. The requirement for a means by which the pressure differential can be rapidly equalized was introduced in the airworthiness regulations for pressurized cabins for transport category airplanes when Part 04

of the CAR became effective on November 9, 1945. Due to the trend to develop pressurized cabins for small airplanes, the 1956 Annual Airworthiness Review established similar requirements for pressurized cabins for small airplanes. The criteria were developed by using the principles which were applicable to pressurized cabins on transport category airplanes since most of the cabin pressure control system design for small airplanes drew heavily upon the equipment designed and developed for transport category airplanes. As a result, many of the provisions added to Part 3 of the CAR by amendment 3-2 effective August 12, 1957, were substantially the same as those which applied to transport category airplanes. Under the recodification program in 1965, Part 23 of the FAR replaced Part 3 of the CAR and these requirements are now in § 23.841(b)(3).

(2) The purpose of this requirement is to provide the crew with a means to rapidly equalize the differential pressure to permit quick opening of the emergency exits and entry door(s) in the event of a gear up landing under emergency conditions. This means may be used for other events such as overpressurization, and reducing cabin contamination. These functions are described in further detail as follows:

(i) Due to a malfunction in the pressurization system or abnormal operational conditions, the cabin pressure is above normal conditions during the airplane landing phase. In this case, the cabin pressure may be vented by the safety-dump valve operated through a manual controller or triggered by the landing gear safety switch so the emergency exits and the cabin entrance doors could be opened.

(ii) If a failure such as a cracked window or windshield occurs, the cabin pressure should be capable of being rapidly reduced so the loads due to cabin pressure differential can be reduced accordingly.

(iii) When a threatening cabin overpressure condition exists, due to cabin pressurization system malfunction, the cabin pressure can be reduced by the safety-dump valve to prevent a structural failure of the pressure vessel.

(iv) When the cabin air becomes contaminated by smoke, fumes, etc., the cabin safety-dump valve may be used depending on the conditions to assist the pressurization and/or ventilation system in evacuation of the cabin air to reduce the contaminants.

b. Cabin Pressure Altitude Warning.

(1) History.

(i) The cabin altitude warning and many of the provisions for pressurized cabins for small airplanes were added to Part 3 of the CAR by amendment 3-2 effective August 12, 1957. Section 3.395(f) of Part 3 of the CAR required, in pertinent part, that the pilot be provided a warning when safe or preset limits on pressure differential and on absolute cabin pressure were exceeded.

(ii) In May 1958, a quantitative requirement was introduced in the airworthiness regulations when FAA established policy for altitude warning on the transport category airplanes. This policy was set forth in section 4b.375-1 and stated, in pertinent part, that the warning for cabin pressure would meet the applicable requirements if it occurred when cabin absolute pressure was reduced below that equivalent to 10,000 feet. Under the recodification program in 1965, Part 25 of the FAR replaced Part 4b of the CAR and the 10,000 feet warning policy was carried over as an appropriate means of meeting the warning requirements in § 25.841.

(iii) As part of the First Biennial Airworthiness Review Program in 1975, amendments 23-17 and 25-28, which changed Parts 23 and 25 respectively, were issued and became effective February 1, 1977. Amendment 25-28 transmitted a minor change to § 25.841 as follows: It changed "cabin absolute pressure is below that equivalent to 10,000 feet" to "cabin pressure altitude exceeds 10,000 feet." Amendment 23-17 brought into § 23.841 of Part 23 a warning indication when the cabin pressure altitude of 10,000 is exceeded. The preamble for this change indicated this proposal was adopted due to a large number of small airplanes having such a warning and many pilots came to rely on this warning.

(2) The purpose of the cabin pressure altitude warning requirement is to indicate a warning at the pilot station when the cabin pressure altitude is greater than 10,000 feet mean sea level (MSL). A possible hazardous condition could be when the airplane reaches the operating altitude which is greater than 10,000 feet MSL, and a malfunction in the cabin pressurization system occurs. If there was no warning for cabin pressure altitude, the cabin pressure altitude could slowly increase undetected to the airplane altitude and the crew and passengers could become unconscious due to hypoxia. The effects of hypoxia are usually encountered when the flight crew is exposed to altitudes above 10,000 feet MSL during extended flights.

5. Acceptable Means of Compliance.

a. Equalizing Time. Assuming isothermal conditions, the time for the pressures to equalize depends on the cabin volume, the effective area of the safety-dump valves, the cabin inflow, and the pressure inside and outside the cabin. If the size of the effective area of the valve is small in comparison to the cabin volume, the rate of pressure change may be too slow for equalizing the pressure differential before an adverse event could occur. The time period to rapidly equalize the cabin pressure should consider maximum certificated cabin pressure differential, operations of the pressurization system, and operation of the emergency exits and/or cabin entrance doors. When landing the airplane under emergency conditions, the safety-dump valve should have sufficient flow capacity to rapidly equalize the cabin pressure within a time period so that the cabin doors and emergency exits are openable and evacuation will not be impaired.

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b. Warnings and Cautions. Section 23.1322 provides specific requirements for the assignment of red and amber for visual indications. Specifically, for abnormal operational or airplane systems conditions, a "caution" should be generated for crew awareness and subsequent crew action may be required; the associated color is amber. Under emergency operational or airplane systems conditions, a "warning" should be generated for immediate crew recognition and when corrective or compensatory action may be required; the associated color is red. If the cabin pressure altitude warning is a visual indicator, it should be red to indicate a hazard.



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